2.44 Water flows downward in a pipe at 45°, as shown in Fig. P2.44. The mercury manometer reads a 6-in height. The pressure drop $p_2 - p_1$ is partly due to friction and partly due to gravity. Determine the total pressure drop and also the part due to friction only. Which part does the manometer read? Why?

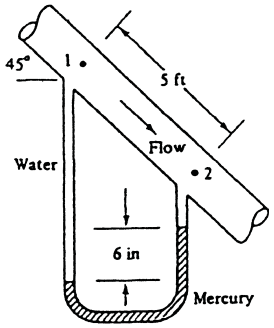

Fig. P2.44

Solution: Let "h" be the distance down from point 2 to the mercury-water interface in the right leg. Write the hydrostatic formula from 1 to 2:

$$p_1 + 62.4\left(5\sin 45° + h + \frac{6}{12}\right) - 846\left(\frac{6}{12}\right) - 62.4h = p_2,$$

$$p_1 - p_2 = \underset{\text{....friction loss...}}{(846 - 62.4)(6/12)} - \underset{\text{..gravity head..}}{62.4(5\sin 45°)} = 392 - 221$$

$$= \mathbf{171}\,\frac{\mathbf{lbf}}{\mathbf{ft^2}} \quad \textit{Ans.}$$

The manometer reads only the *friction loss* of 392 lbf/ft^2, not the gravity head of 221 psf.

2.45 Determine the gage pressure at point A in Fig. P2.45, in pascals. Is it higher or lower than $P_{atmosphere}$?

Solution: Take γ = 9790 N/m^3 for water and 133100 N/m^3 for mercury. Write the hydrostatic formula between the atmosphere and point A:

$$p_{atm} + (0.85)(9790)(0.4\text{ m}) - (133100)(0.15\text{ m}) - (12)(0.30\text{ m}) + (9790)(0.45\text{ m}) = p_A,$$

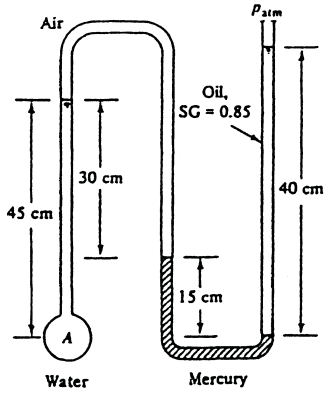

Fig. P2.45

or: $p_A = p_{atm} - 12200\text{ Pa} = \mathbf{12200\ Pa\ (vacuum)}$ *Ans.*
